

# TEMPERATURE IN CHOLERA.

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THE hospital in which the following observations were made was one of four devoted to the reception of cholera patients in Berlin. In ten weeks 820 cases were treated in it alone. The demands of so many sick of an urgent disease, their restlessness and agonized intolerance of restraint, and the time necessary to make each single observation trustworthy, which was at least half-an-hour, were all circumstances which made the study difficult. Still, the author believes that his paper, as much by the accuracy as by the number of the observations, will furnish a contribution not without value to thermometry, and thus, possibly also to our knowledge of the cholera process itself.

The coldness of surface of cholera patients was first noted by touch; and the first use of the thermometer in the disease was to verify this observation. It is, however, impossible thus to ascertain the general state of the body. The extremities and external surface cool so quickly that the temperature of the limbs, skin, mouth, &c. is much lower than that of the trunk, and can yield no conclusion regarding that of the blood. We can only determine the temperature of the entire body by observations in one of its apertures, the vagina or rectum, which, more richly supplied with blood, does not suffer such a rapid loss of heat to the surrounding atmosphere as the external parts mentioned. Measurements in the vagina are most quickly taken, and not liable to be spoiled by the discharges, which render the rectum less available. Still less useful for thermometry in cholera, at least in its first stages, is the closed axilla, the temperature of which, compared with that of the vagina and rectum, shows a difference of one or more degrees. We were often, however, for various reasons, compelled to resort to the axilla. In the stage of reaction it is as trust-

\* From Virchow's *Archiv für patholog. Anat. und Physiologie* for January. The observations in the original are given in degrees centigrade, which have been reduced to Fahrenheit's scale, for convenience of comparison with the measurements given hitherto in the medical writings of this country.—J. B. R.

worthy as in other diseases. Observations in the vagina were abandoned when it became the seat of diphtheritic exudation. Finally, all the thermometers used must be compared with a standard, and agree to a tenth at least. Our thermometers were divided according to the centigrade scale.

Though observations were made in 1831, the first which merit a reference were taken in the epidemic of 1848-50. The statements of different authors differ widely. Whilst some, and especially Von Bärensprung,\* record a general fall in the temperature of the body in the algide stage, others, as Zimmermann,† note a rise in the internal parts. The former says the loss of heat is not only external, but general; that in the internal parts it may be inconsiderable; but, at all events, the temperature does not rise. Zimmerman, from only two observations, drew opposite conclusions. Briquet and Mignot‡ concluded that the greatest fall in the temperature of the entire body takes place in the algide stage. However, they also frequently found a rise. A fall in that stage they considered an unfavourable, a slight rise a favourable, symptom, though they found many exceptions to both rules. Their measurements were entirely axillary, and therefore of little value, and the conclusions from them fallacious. In the algide stage the temperature of the axilla is considerably lower than that of the internal apertures of the body. Similarly opposed statements were made by other authors. Griesinger§ regarded the elevated temperature observed in some cases as the forerunner of death, as in other diseases, especially typhus.

In the stage of reaction, according to Von Bärensprung, the temperature rises from the associated fever. Zimmermann advances similar opinions. Briquet and Mignot usually found a rise of one degree centigrade ( $1.8^{\circ}$  F.), but in some fatal or complicated cases the temperature fell.

The following observations show that, in general, these contradictions do not depend on mistaken, but on incomplete data. We have adopted the classification of the cases employed in the Hospital records.

TABLE I.—*Asphyxiated cases, terminating in death during asphyxia.*

This table comprises 45 cases. The sex, age, day of the disease when the temperature was taken, and the number of hours before death, are all given in separate columns, with short remarks as to peculiar symptoms, rapidity of course, &c.

\* Müller's *Archiv*, 1852.

† *Deutsche Klinik*, 1856.

‡ *Traité pratique et analytique du Cholera-Morbus*. Paris, 1850.

§ Virchow's *Handb. der spec. Pathol. und Therap.*, 2d. Edition, p. 418.



The observations were made in the axilla, vagina, and rectum. The conclusions deduced are :

1. In all the cases, with the exception of six, the temperature of the vagina and rectum was normal or still more frequently elevated.\* The statement of Von Bärensprung, that in the algide stage of cholera, the diminution of temperature is general is therefore erroneous. Nor can we accept in its generality Zimmermann's assertion that the internal temperature is raised, and therefore cholera must be regarded as an inflammatory or febrile disease.

2. The difference between the temperature of the axilla and that of the vagina and rectum is not constant, but varies according to these observations, between  $1.6^{\circ}$  and  $6.6^{\circ}$ . The temperature taken in the axilla in the algide stage of cholera is therefore not sufficient for the determination of the general temperature of the body. It, at most, permits an approximate conclusion regarding the minimum temperature of the apertures, by the addition of  $1^{\circ}$  C. ( $1.8^{\circ}$  F). The fallacy of the conclusions drawn by Briquet and Mignot from their axillary observations, will now be apparent. Numerically the measurements made by us in the axilla yield a result exactly the opposite of those taken in the vagina and rectum. Of 31 axillary observations, 21 were under the normal; and of 54 vaginal and rectal only 12. The mean of the 31 taken in the axilla is  $97.8^{\circ}$ ; while the mean of the 54 taken in vagina or rectum is  $100.94^{\circ}$ .

3. In the greater proportion of the cases an elevation of the temperature of the internal parts occurred, and in many, reached a point which we observe only in the most severe febrile diseases, in a few even approaching the highest which has in general been observed in the human body (in one case  $108.3^{\circ}$ ). Although in many of the cases this high temperature has been observed shortly before death, it also appeared in several, when certainly no sign of the death-struggle yet existed. In these instances, at least, it could not be reckoned a forerunner of death, and much less so that an almost equal elevation has been found in the algide stage in asphyxiated cases which recovered.

4. Among these 45 cases there are only 6 in which the general temperature of the body (vaginal and rectal) was below the normal, and then only by  $0.9^{\circ}$  to  $3.4^{\circ}$  at the most. In these six cases the symptoms were not different from those of the other cases in which the temperature was raised or normal: there were the same symptoms of asphyxia, the same pulseless-

\* The normal temperature in the axilla is taken at  $98.6^{\circ}$  F. in the; vagina and rectum at  $99.5^{\circ}$  F.; the vagina, however, being from two to three tenths higher than the rectum.

ness, lividity, and collapse. In three of these cases the course of the disease was less rapid than in the rest; five were females above 40 years of age, one a man of 32. But neither the course of the disease nor symptomatology, nor the anatomical condition; neither age, nor sex, nor constitution, have as yet furnished an explanation of the differences of temperature in individual cases during the algide stage of cholera.

TABLE II.—*Cholera cases which, without sequelae, terminated in recovery.*

These are subdivided thus:—*a*, Asphyxiated cases (3); *b*, partially asphyxiated cases (3); *c*, mild cases (4). The same facts are recorded with reference to each case as in last table, with the addition of a note of the time when reaction began, and the conclusions arrived at are:

1. In the algide stage, even in the diarrhoeal stage of the milder cases, the temperature of the internal parts of the body was almost always elevated, in one case reaching 103.28°.

2. With the commencement of reaction and during its course, the temperature of the inner parts of the body by no means rises; on the contrary, falls for the most part to an inconsiderable extent, while the temperature of the extremities rises. The contrary statements of Von Bärensprung and others are thus refuted.

3. It is remarkable that even after the commencement of reaction, and when the patient has become perfectly well, still the temperature of the body frequently remains for a long time elevated, while the most careful examination cannot discover any organic derangement.

TABLE III.—*Cholera cases complicated with sequelae.*

This table contains 23 cases. Added to the facts recorded as in previous tables, is a note of the special sequela and the day of its appearance, with termination in recovery or death. The sequelae noted are, the cholera-exanthem, erysipelas, cramp of the flexors, pneumonia, parotiditis and typhoid.\* Only a select number of the cases on which observations were made have been published. The conclusions regarding the individual complications of cholera are these:

1. With the appearance of the *cholera-exanthem*, sometimes even some days before it, the temperature of the body is in certain cases elevated. This occurs also on the appearance of *erysipelas*. In a few cases, however, the exanthem exercised no influence on the temperature. With its disappearance, the temperature usually subsides, unless kept up by some new morbid process.

\* Meaning a state more or less tending to coma, very often associated with suppression or derangement of the urinary function.



2. An elevation of temperature generally occurs on the commencement of *pneumonia*, but in some cases it remains almost normal or even falls somewhat. A precise course with critical days has not been observed in this form of pneumonia. Still, the regular daily variations are recognisable in the rise of temperature, which usually takes place at night. A fall, however, has also been occasionally observed.

3. The most marked rise in temperature is observed on the appearance of *parotiditis*. Since this sequela is generally sudden in attack, and rapid in its course, the rise is also usually hurried. When the parotiditis shows itself more slowly, the temperature rises gradually. In no other sequela of cholera have we observed a temperature so extremely and so lastingly high as with the fully formed and suppurating parotiditis. Supervening erysipelas sent up the thermometer, though it had begun to fall. In one case, in which the swelling dispersed without suppuration, the temperature kept pace with it in falling.

4. During the spasmodic *contraction of the flexors* in the upper and lower extremities, observed in some cases for a few days during convalescence, the temperature was usually somewhat elevated.

5. During the *typhoid* state we but seldom found the temperature elevated. It was either normal, or, where the typhoid arose from uræmia and resembled protracted asphyxia, usually lowered; in some falling even up to the time of death, so that in one case, twenty-four hours before death, the temperature in the rectum was  $94.46^{\circ}$ , and three hours before death in the axilla,  $90.68^{\circ}$ ; and in another, half-an-hour before death,  $91.58^{\circ}$  in the vagina. Even with a flushed countenance and delusive excitement, the general temperature was in one case barely raised, and in another even lowered.

TABLE IV.—*Post-mortem Observations.*

The observations made in 12 cases before and after death are here recorded. They were mostly rapidly fatal, deeply asphyxiated cases. The temperature of the ward ranged from  $64^{\circ}$  to  $75^{\circ}$ , and the bodies were covered with light woollen cloths.

Even in the first epidemic, in 1831, some asserted that they had observed a remarkable development of heat in cholera bodies, and since then this observation has been repeated with every epidemic. Von Bärensprung explained this surprising phenomenon thus: "That the paralysis preceding death relaxes the contracted blood-vessels, that in this way a returning flow of blood into the expanding vessels of the skin is permitted, and so there follows an equal distribution of the heat."\*

\* *Ibid*, p. 259.

He has himself, however, made no thermometric observations relative to this fact. Briquet and Mignot believe that they have established by numerous axillary measurements (among which only one is of value, because only it was made immediately before and immediately after death), that in the first moments which follow a death from cholera, there sometimes occurs a rise of the temperature not merely in appearance and to the touch, but also in fact, and measureable by the thermometer. They would explain the phenomenon in this way—that the dead body does not produce more heat than the living, but the skin of the former possesses a greater power of giving off heat, because in the living there is a continual loss of heat through the sweat and cutaneous exhalations, which ceases in the dead body. Doyère\* has found, by a series of observations, that a thermometer placed in the axilla of a cholera patient rises constantly from the commencement of the death-struggle even up to the last breath, remains at its height from 15 to 30 minutes, but after that falls. That cholera patients become warmer after death is therefore a mistake.

Among the twelve cases in the table, in three the temperature observed after death exceeded that before death, but the interval between the observation before death and the event being one and more hours in these cases, probably the temperature rose in the interval. In five cases it is positively shown that the temperature taken shortly after death was not higher than shortly before death. In no case has a rise of temperature been observed in the dead body from the moment of death. Our investigations, therefore, have not convinced us of the *post-mortem* rise of temperature in cholera. But should it actually occur it would find its analogue in similar observations in tetanus made by Wunderlich† and Leyden.‡ In this case Leyden has attributed the rise of temperature to the heat discovered by Ziemssen to be produced by muscular contraction. Such muscular contractions, as is well known, frequently occur in cholera bodies, and might therefore furnish an explanation of this questionable *post-mortem* rise. However, in both cases where we observed unusually violent *post-mortem* contractions, we were unable to discover any increase of temperature; much less in another instance of convulsions preceding death.

In conclusion, we have embodied the results of our observations in the following general propositions:—

1. In the algide stage of cholera there occurs a remarkable

\* *Observations sur la respiration et la température des cholériques—Compt. rend* 1849, p. 454.

† *Archiv. der Heilkunde*, 1861-62.

‡ *Virchow's Archiv*, &c., Vol. 26, p. 538.

cooling of the parts of the body attached to the trunk (head, extremities), such as is found in hardly any other disease.

2. In the algide stage of cholera the temperature of the apertures of the trunk (vagina and rectum) is the highest (measureable) in any part of the body, and alone can determine the true temperature of the entire body.

3. In the algide stage, in most cases, whether they end in death or recovery, the internal temperature of the body is raised, seldomer normal, seldomest of all lowered. The cause of this difference is not as yet apparent in the pathological appearances during life, or in those found after death.

4. In the algide stage, the temperature of the entire body usually rises with the approach of death, and up to its occurrence. No elevation after it seems to take place. Yet cases also occur in which the death-struggle produces no rise in temperature, without the cause of this anomaly being discoverable.

5. With the commencement of uncomplicated reaction no rise of temperature occurs, but much more usually a slight cooling of the inner parts of the body, while the outer become warmer.

6. In cases of protracted reaction (prolonged asphyxia), the temperature of the entire body usually sinks below the normal.

7. The inflammatory sequelæ imply, not always, but still in the great proportion of cases, a decided rise of the temperature of the entire body.

8. During complete convalescence an abnormally elevated temperature is frequently observed, without a pathological cause sufficient to account for it being apparent.



